# Dynamics of Rainwater Harvesting (RWH) in Botswana: Understanding the Socio-economic Aspects for Effective Implementation of Programmes and Policies

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## Abstract

A selected number of rural and urban centres in Botswana were randomly selected, and surveyed in an effort to capture the sentiments with regards to RWH as an additional source of water to augment their supply. The aim of the survey was to use the findings and inform future government and/or donor agencies, policies, and projects in an effort to ensure that RWH initiatives are sustainable, and also significantly improve the lifestyles of the targeted community(ies).

The survey captured information across the following market segments: Domestic, Agriculture, Institutions, and Commercial and/or Industrial set-ups. Of a total of 1273 questionnaires were administered country-wide, the majority (88.3% of the sample size) of people in Botswana are interested in harvesting rainwater and even though currently do not have RWH systems. The majority of those without the expected systems however, stated that they need an incentive from the government in the form of government subsidies In addition, a majority of the people interviewed also preferred the taste of rainwater to water from their conventional water supply.

## 1. Introduction

At the time of independence Botswana was one of the poorest countries in the world, and the majority of Batswana did not have access to clean running water. They relied on natural water sources such as boreholes and (small) dams. Although not well documented, it is believed that they also used to collect rainwater running off-ground surfaces in excavated pits and from eaves of thatched roofs into pots and other small containers for centuries (Gould and Jay, 1993). Hence, after independence one of the most of important tasks that the government of the time wanted to achieve was to increase the access to potable water to the majority of the citizens. From the Millennium Development Goals Status Report of 2004, it can be said that this has been achieved, since 97.7% of the proportion of the population of Botswana have sustainable access to safe drinking water (Government of Botswana and UNDP, 2004). There are also settlements with population less than 250 people, which though not recognized for water reticulation planning, they are provided with potable water (National Water Master Plan Review, Vol. 6, March 2006).

In spite of the above commendable efforts, the country still experiences acute water scarcity problems during dry seasons, and during recurrent droughts. These events affect especially those living in the rural areas. RWH could have a niche under such circumstances. The government initiatives in RWH can be traced back to 1979 when the Arable Lands Development Programme (ALDEP) was launched (Gould and Jay, 1993). The programme was such that, Batswana owning fewer than 40 herds of cattle can participate and they receive 85% subsidy from the government towards construction of the catchment and storage

of the RWH system. Despite the generous assistance, some farmers found the 15% down payment prohibitive and the programme remained under-subscribed until it was shut down in 1983 because it did not produce the desired results. With a second phase in the 1990s, government spent about P160 million on ALDEP, but it appeared that the results were not commensurate to the huge spending (www.gov.bw/cgi-bin/news, 29 September, 2006). However, government recognizes the importance of RWH as a water conservation strategy, and a similar programme is to be launched during the second quarter of this year.

Research done with regard to RWH shows there is a general admission that past projects in developing countries have not achieved the desired impact because they failed to appreciate the social, economic and institutional components of the targeted communities (Lee, et al., 1991). Rutashobya (1995) concluded that socio-economic aspects have to be carefully observed and satisfied in order to have successful utilization of rainwater catchment systems in the third world. Hence to achieve any sustained growth and development in RWH technologies the socio-economic aspects of the targeted population have to be taken into account

Botswana Technology Centre instituted a survey whose main aim was to investigate the feasibility of RWH as a means of supplementing the current water supply. It is hoped that such information can be used to inform future projects and programmes for effective implementation and therefore sustained development in the area of RWH in Botswana. Although data gathered during the survey ranged from opinions on RWH technologies to environmental effects of RWH, this paper aims to present only the findings of the socio-economic aspects of the survey.

## 2. Results and Discussion

The responses from the questionnaires were collected and analysed using the SNAP software for surveys. The following section presents a discussion of the socio-economic findings.

### *Population dynamics and RWH trends*

The sample size consisted of both rural and urban centres which were randomly selected from a number of different districts in Botswana. Consequently the sample size also represented respondents with different socio-economic backgrounds and also areas with different rainfall patterns. The Central District had the highest number of respondents with representation of 26.9% of the entire sample size and this was followed by the North West district which had 11.2% representation. A presentation of the location of the respondents along with number of respondents with RWH systems per location is depicted in Table 1 below.

Over 80% of respondents do not have RWH systems either in their households, institutions, farms or commercial/ industrial establishments. The Central District had the highest number of respondents with RWH systems at 2.5% and this is followed by the Southeast District at 1.6%. This indicates that there is a great potential for the promotion of RWH in the various sectors of the socio-economic spectrum and also across many regions of this semi-arid country that suffers from frequent droughts.

| Base % Respondents | Base | Missing | Do you have a rainwater system | |
|---|---|---|---|---|
| | | No reply | Yes | No |
| **Base** | **1273** | **0.2%** | **11.5%** | **88.3%** |
| **Missing** | | | | |
| **No reply** | **-** | - | - | - |
| **District** | | | | |
| **Gaborone City** | **5.4%** | 0.1% | 0.1% | 5.3% |
| **Kgatleng** | **3.5%** | 0.1% | 0.8% | 2.7% |
| **South East** | **5.4%** | - | 1.6% | 3.8% |
| **Kweneng** | **6.0%** | - | 0.8% | 5.2% |
| **Southern** | **10.4%** | - | 1.4% | 9.0% |
| **Kgalagadi** | **6.9%** | - | 1.3% | 5.7% |
| **Gantsi** | **7.4%** | - | 1.0% | 6.4% |
| **North West** | **11.2%** | - | 1.2% | 10.1% |
| **Chobe** | **5.8%** | 0.1% | 0.5% | 5.2% |
| **Central** | **26.9%** | - | 2.5% | 24.4% |
| **North East** | **5.3%** | - | 0.2% | 5.0% |
| **Francistown** | **5.8%** | - | 0.1% | 5.7% |

**Table 1: RWH practices and distribution of respondents**

## Respondents with RWH systems

### *Cost of the systems and source of funding*

| Analysis % Respondents | Base | Missing | How much did you invest on building the system? | | | | |
|---|---|---|---|---|---|---|---|
| | | No reply | <P1000 | P1000-P5000 | P5000-P10000 | >P10000 | Don't know |
| **Base** | **1268** | **89.2%** | **0.7%** | **2.0%** | **0.8%** | **0.3%** | **7.0%** |
| **Missing** | | | | | | | |
| **No reply** | **1127** | 99.7% | - | 0.1% | - | - | 0.2% |
| **What is the source of funding for the system?** | | | | | | | |
| **Government schemes** | **82** | 7.3% | - | 1.2% | 1.2% | 2.4% | 87.8% |
| **Commercial Banks** | **1** | - | - | - | - | 100.0% | - |
| **NGO** | **-** | - | - | - | - | - | - |
| **Own Funding** | **59** | 1.7% | 15.3% | 39.0% | 15.3% | 3.4% | 25.4% |
| **Community efforts (Ipelegeng)** | **-** | - | - | - | - | - | - |

**Table 2: Cost of RWH systems and source of funding**

The above table shows that a majority (7.0%) of the respondents with RWH were not aware of the cost of their systems and this is attributable to the fact that 87.8% of the respondents with RWH systems were occupying government houses or heading institutions such as schools and colleges. Consequently most of them were not directly involved during their set up nor did they make any contribution towards the initial capital cost. A large number

(39.0%) of respondents, however, with RWH systems contributed from their own savings in the range between P1000 – P5000.00 (USD161.80 – 809.00) for the set up of these systems, while 15.3% contributed between P5000 and P10 000.00.

***Affordability of the system***

| Analysis % Respondents | Base | Missing | Ground | |
|---|---|---|---|---|
| | | No reply | Yes | No |
| **Base** | **1273** | **89.2%** | **8.3%** | **2.4%** |
| **Missing** | | | | |
| **No reply** | **1136** | 99.3% | 0.2% | 0.5% |
| **How much did you invest on building the system?** | | | | |
| **<P1000** | **9** | - | 100.0% | - |
| **P1000-P5000** | **25** | 4.0% | 88.0% | 8.0% |
| **P5000-P10000** | **10** | - | 80.0% | 20.0% |
| **>P10000** | **4** | - | 50.0% | 50.0% |
| **Don't know** | **89** | 7.9% | 70.8% | 21.3% |

**Table 3: Opinions on affordability of the system based on its cost**

When queried on the affordability of their systems, a majority of the respondents (8.3%) maintained that their system was affordable. All respondents whose systems had a "price tag" of P1000.00 and below felt it was affordable. Surprisingly, a large number of respondents whose system was in the range of P5000.00 and P10 000.00 also felt that their system was affordable! Another noticeable statistic is the fact that a majority of respondents (70.8%) who did not have specific cost of their systems felt that their systems were affordable. Based on information derived from on Tables 2 and 3, there is an opportunity for local contractors to develop RWH systems that cost between P1000.00 and P5000.00 since most respondents currently having them thought this was affordable and they acquired their systems from their own savings.

***Use of the harvested rainwater***

Out of the population with RWH systems, 7.6% of the respondents used the harvested water whenever it is available, that is as soon as there is rainwater in the storage tanks/ facilities they went ahead and used it. 4.2% of respondents with such systems also maintained that they only used their harvested rainwater when their current supply is broken down or its supply is insufficient, while the remaining 0.5% used the harvested rainwater during the dry season.

Consequently most respondents with RWH systems have had their harvested rainwater depleted between the rainy seasons as depicted in the table below.

| Analysis % Respondents | |
|---|---|
| Base | 100.0% |
| Missing | |
| No reply | 89.1% |
| When do you normally use your harvested rain water? | |
| Whenever its available | 7.6% |
| When other supply(s) is insufficient or broken down | 4.2% |
| During the dry season | 0.5% |

**Table 4: When do the respondents practicing RWH use this water?**

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| Analysis % Respondents | Base | Missing | Does your tank ever empty between rainny seasons? | |
|---|---|---|---|---|
| | | No reply | Yes | No |
| Base | 1273 | 88.9% | 7.6% | 3.5% |
| Missing | | | | |
| No reply | 1134 | 99.7% | 0.3% | - |
| How often do you use the harvested rainwater? | | | | |
| Freqently | 78 | - | 74.4% | 25.6% |
| Occasionaly | 45 | - | 57.8% | 42.2% |
| Hardly | 16 | 6.3% | 62.5% | 31.3% |

**Table 5: Sustainability of harvested rainwater between rainy season against when the harvested rainwater is normally used.**

It is however worth mentioning that frequency and time of use are pre-determined by performance of current water supply sources. There is therefore a need for controlled use of harvested rainwater for greater communal benefit. There is also an opportunity to assess appropriateness of size of storage devices based on when most people would need rainwater.

## Respondents without RWH systems

### *Why they do not have RWH systems*

From Table 6, 40.5% of respondents without RWH systems did not have them because they could not afford them, while 14.8% said they were not knowledgeable. Quite noticeable also is the fact that an ignorable number (0.1%) said they did not have such systems because of both religious and cultural beliefs respectively, while 10.2% of respondents maintained that had no interest in RWH. Two opportunities arise here: first one being a need for more education on the importance of RWH in order to stimulate knowledge and ultimately interest; second, while most people want to have such systems there is still the critical issue of ensuring that they are affordable to an average citizen.

| Analysis % Respondents | |
|---|---|
| Base | 100.0% |
| Missing | |
| No reply | 36.9% |
| Why are you not having the rainwater harvesting system? | |
| Cannot afford it | 40.5% |
| Not knowledgeable | 14.8% |
| No interest | 10.2% |
| Religiious belief | 0.1% |
| Cultural belief | 0.1% |

**Table 6: Reasons for not having RWH systems**

***Ability to invest in a RWH system***

| Analysis % Respondents | |
|---|---|
| Base | 100.0% |
| Missing | |
| No reply | 27.6% |
| How much are you willing to invest in the system? | |
| P1000-P1500 | 12.1% |
| P1500-P2000 | 11.2% |
| >P3000 | 18.6% |
| Can not afford | 30.6% |

**Table 7: Amounts respondents would be able to invest for a RWH system**

Respondents without RWH systems were further asked on their ability to invest in such systems if they were given an opportunity and a majority of them felt that they could not afford such systems while a large number (18.6%) felt that they could afford the system even if it was to cost above P3000.00. 23.3% of respondents also maintained that they could only afford RWH systems if they cost less than P2000.00. This indicates that previous government assistance initiatives that were administered under various programmes might still be needed and the people conscious of the possibility of help being very close to them. Table 7 further confirms discussions made about affordability of such systems as discussed regarding Table 6.

**General Sentiments of all Respondents on RWH**

***Opinions about harvested rainwater***

According to Table 8 35% of respondents felt that harvested rainwater was clean enough to be used. 22.2% of respondents felt that it was tastier than their current source of water supply. 4.2% of respondents however did feel that harvested rainwater was not clean enough for human consumption hence it should only be used for irrigation and watering animals.

| Analysis % Respondents | |
|---|---|
| Base | 100.0% |
| Missing | |
| No reply | 37.4% |
| Variable V7 | |
| Clean enough | 35.0% |
| It has no chemicals | 5.3% |
| It is tastier than current source | 22.2% |
| It is natural | 7.4% |
| Contains less salts | 1.9% |
| It is soft | 1.4% |
| Only safe for irrigation and watering animals | 4.2% |

**Table 8: General opinions held about harvested rainwater by the respondents**

***Measures normally undertaken to improve quality harvested rainwater***

| Analysis % Respondents | |
|---|---|
| Base | 100.0% |
| Missing | |
| No reply | 65.4% |
| Variable V8 | |
| Boil before use | 28.6% |
| First flush | 2.8% |
| Filtration | 1.6% |
| Use chemicals | 0.9% |
| It is clean enough | 2.4% |
| Clean tanks regularly | 2.4% |

**Table 9: Measures normally undertaken to try and improve the quality of the harvested rainwater.**

Table 9 shows that an overwhelming majority of respondents felt that harvested rainwater had to be boiled before it is put to any use. Some respondents felt that inclusion of first flush is significant in ensuring that harvested rainwater is clean. It can be concluded that people are aware of the need to treat contaminated water, including rainwater.

***Improvement of RWH technologies***

From Table 10, 69.5% of the respondents think that more education and awareness is important in the improvement of RWH technologies. Another 50.4% also place cost-effectiveness as a priority. These are important aspects of delivery if the practice is to be popularised. A good number also suggest that this could be achieved through a different approach in the design of the systems. This seems to fit the responses or sentiments of the users of some of those systems that have been installed before, and whose performance has been dismal

| Base % Respondents | |
|---|---|
| Base | 100.0% |
| Missing | |
| No reply | 6.2% |
| How do you think the RWH technologies can be improved? | |
| Design aspects | 43.4% |
| Make them cost effective | 50.4% |
| More education and awareness campaigns | 69.5% |
| More consultants during formulation of technologies | 25.5% |

**Table 10: Ways in which RWH technologies can be improved**

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***Preferred RWH systems***

| Base % Respondents | |
|---|---|
| Base | 100.0% |
| Missing | |
| No reply | 2.6% |
| Which of the following systems would you prefer? | |
| Communal rainwater harvesting system | 18.3% |
| Private rainwater harvesting | 80.7% |

**Table 11: Preferred RWH system**

The majority of respondents prefer a system which they alone can look after and use. It would therefore be counter-productive for any government agency or NGO to develop RWH system that is to be operated and maintained by the community without their participation.

***Potential benefits of practicing RWH***

The results shown in Table 11 indicate that people are quite aware of water scarcity, and would associate RWH with possibility of reducing this scarcity. Equally important are the steadily rising costs of reticulated mains water supply, which is reflected by 85% of the respondents mentioning that RWH would help in reducing bills.

| Base % Respondents | |
|---|---|
| Base | 100.0% |
| Missing | |
| No reply | 0.7% |
| What benefits would you associate with RWH systems? | |
| It can alleviate the water scarcity problem | 83.5% |
| Can create employment thereby alleviating poverty | 41.7% |
| Reduce water bills | 85.0% |
| Source of personal bills development | 54.5% |
| Increase food security | 54.7% |
| Can increase income generating projects | 54.2% |
| No benefits | 2.0% |

**Table 12: Recognizable benefits that could result from practicing RWH**

***Initiatives needed to encourage RWH***

| Base % Respondents | |
|---|---|
| Base | 100.0% |
| Missing | |
| No reply | 2.1% |
| What initiatives would you like to see in place to encour... | |
| Government subsidies | 79.6% |
| Easy access to funds | 49.9% |
| High piped water bills | 14.4% |
| More educational materials on RWH | 73.0% |
| There are enough initiatives | 1.0% |

**Table 13: Initiatives needed to encourage RWH**

Government policies and programmes geared towards RWH have always had subsidies as its cornerstone. It is therefore not surprising that 79.6% of the respondents as shown on Table 13 think this trend should continue to be encouraged. Any change would need tremendous motivation and education.

*Market segments which would benefit more from having a RWH system*

| Base % Respondents | |
|---|---|
| Base | 100.0% |
| Missing | |
| No reply | 1.5% |
| Which of the following water users do you think would ben... | |
| Institutions | 60.3% |
| Domestic | 68.7% |
| Agriculture | 87.2% |
| Industries (Commercial and Manufactureing) | 50.7% |

**Table 14: Market segments that are believed could benefit from RWH**

Given the rainfed conditions under which agriculture is usually practiced in Botswana, it is not alarming to observe that 87.2% of respondents would like RWH to be encouraged within the agriculture sector, thus boosting efficiency of food production. .

## 3. Conclusions

In addressing the socio-economic aspects of RWH in Botswana, the paper addressed sentiments of those with, and those without, RWH systems. Parameters included cost of the systems, source of funds, and frequency of use of the harvested rainwater. General perceptions with regard to use of RWH to augment water resources were also investigated. The following conclusions can be drawn:

1. RWH is one initiative that can easily be absorbed and practiced by most Batswana.
2. The issue of affordability is a major deterrent among those without RWH systems.
3. Public education and awareness about RWH in general is essential to motivate and encourage efficient utilisation of the harvested rainwater for greater communal benefit.

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